PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
B41M 3/14 // B42D 15/10

A1

(11) International Publication Number: **WO 98/40223**

(43) International Publication Date: 17 September 1998 (17.09.98)

(21) International Application Number: PCT/US98/04672

(22) International Filing Date: 10 March 1998 (10.03.98)

(30) Priority Data:

08/814,966	11 March 1997 (11.03.97)	US
08/936,648	3 November 1997 (03.11.97)	US

(81) Designated States: CA, JP, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

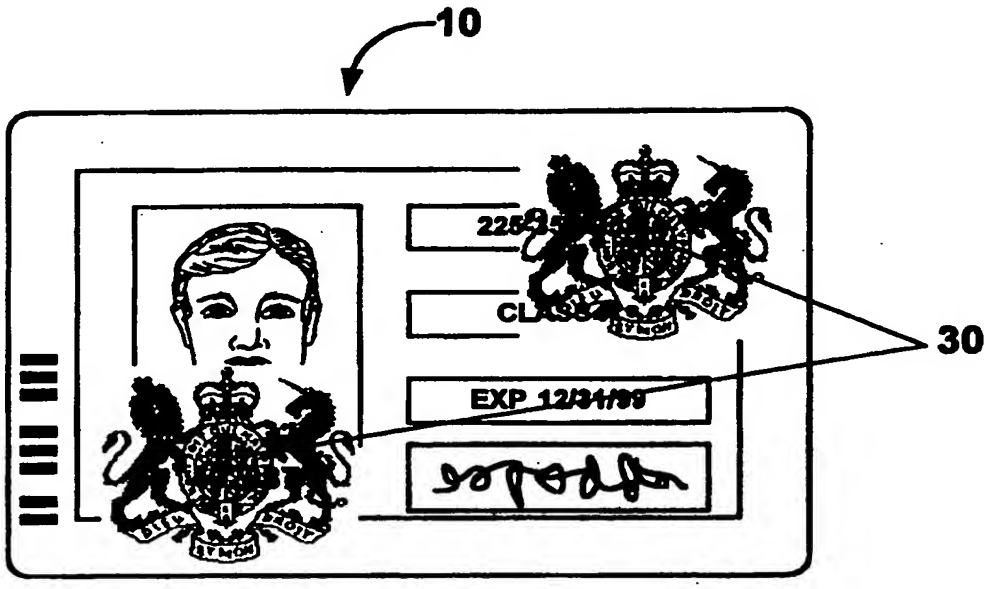
Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(71) Applicant: POLAROID CORPORATION [US/US]; 549 Technology Square, Cambridge, MA 02139–3589 (US).

(72) Inventors: DEMERS, Audrey, G.; 525 Andover Street, Lowell, MA 1852 (US). NESTOR, John, W., Jr.; 11–6 Deer Path, Maynard, MA 01754 (US). RICE, William, C.; 29 Causeway Street, Medway, MA 02053 (US). RICHARDSON, Jack, T.; 29 Robbins Road, Arlington, MA 02174 (US).

(74) Agent: COLE, David, John; Polaroid Corporation, 549 Technology Square, Cambridge, MA 02139–3589 (US).

(54) Title: SUBSTRATE WITH NON–VISIBLE INDICIUM



(57) Abstract

A substrate bears essentially non–visible image formed from at least two fluorescent and/or phosphorescent inks, both or all of which are capable of being excited by a single band of non–visible radiation. The fluorescent and/or phosphorescent inks upon excitation by the appropriate radiation produce visible radiation of two or more different colors, with differing areas of the non–visible image displaying differing colors, so that a full–color image becomes visible. The substrate may also bear visible indicia, and may have the form of, for example, an identification document or a container for goods.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

SUBSTRATE WITH NON-VISIBLE INDICIUM

This invention relates to a substrate, and to a process for the manufacture of such a substrate. More specifically, this invention relates to a substrate which bears a fluorescent and/or phosphorescent image. In many but not all cases, the fluorescent and/or phosphorescent image serves as a security or authentication feature for the substrate, which may be in the form of an identification document.

Identification documents typically comprise a card or document usually containing visible indicia relating to the bearer of the document; often, these indicia include a photograph of the bearer. Normally, the card is protected by a plastic sheet material such as by lamination of the card to a plastic sheet material or, as is usually the case, by lamination of the card between plastic sheet materials. Identification documents have many uses and their uses are increasing. For example, such documents may be used to establish a person's authorization to conduct certain activities (e.g., driver's licenses), their authorization to have access to certain areas (e.g., employee identification cards) or their authorization to engage in credit transactions (e.g., credit cards). In view of these widespread uses, especially in commercial transactions, such as cashing checks, credit purchases, etc., it is important that the person relying on the identification document to identify the bearer have maximum assurance that the identification document has not been altered and/or is not a counterfeit.

The counterfeiting of identification documents involving as it does the fabrication and issuance of identification documents by persons not authorized to do so presents difficult security problems. Perhaps the most effective way to prevent counterfeiting would involve strict control over the possession of the materials and equipment involved in the fabrication of identification documents. In most cases, however, this approach would be impractical or impossible. For example, too many of the materials involved are commercially available and used in other applications. Instead, the art's response to the counterfeiting problem has involved the integration

of "verification features" within identification documents to evidence their authenticity. The best known of these "verification features" involve signatures such as the signature of the issuer or bearer of the identification document. Other "verification features" include watermarks, validation patterns or markings and polarizing stripes.

Such verification features may be divided into two broad categories according to whether the feature is visible to the naked eye or not. Visible verification features have the advantage that they can be checked without the use of special equipment. However, recent improvements in photocopying apparatus, especially such apparatus capable of reproducing color images, has reduced the ability of visible verification features, in that most features which can be checked visually can also be counterfeited relatively easily by photocopying techniques.

Accordingly, there is an increasing need in identification documents for "invisible" verification features, that is to say features which are not checked simply by the human eye in natural lighting. Such features may include printed indicia which reflect light only at non-visible wavelengths, and which are read by machines which can illuminate the identification document with the appropriate non-visible radiation and read the results. However, the use of such machines has the disadvantage that if the machine malfunctions a valid identification document may be rejected (resulting in, for example, a justifiably aggrieved customer if the identification document is a credit card, or more serious consequences if the identification document is a passport) and there may be no easy way to determine whether the machine is operating correctly. Accordingly, it is normally preferred to use as an invisible verification feature one or more indicia which are not visible to the naked eye in conventional room lighting but which, upon exposure to special conditions, typically non-visible radiation, display a visible indicium. Such verification features usually involve the use of fluorescent or phosphorescent materials.

Invisible verification features using fluorescent or phosphorescent materials have the advantage that the non-visible radiation sources required to enable the features to be seen are normally ultraviolet bulbs or tubes emitting radiation in the near ultraviolet range of about 280 to about 400 nm, and such bulbs or tubes are readily available, inexpensive and reliable. Furthermore, such sources also emit some visible light, so that if the source fails, this is immediately apparent and there is no risk of inadvertently refusing a valid identification document because of a failure of the reading device.

Among the various proposals for the use of fluorescent or phosphorescent materials in identification documents are US-A-4 151 667 and 4 219 599, which both describe laminated documents such as I.D. cards using a phosphorescent material as a verification or validation pattern. US-A-4 387 112 describes identification cards which may be identified as genuine through the use of stimulatable inorganic phosphor compositions. US-A-5 005 873 describes a substrate having markings which are provided by at least two fluorescent materials which have different excitation spectra in the ultraviolet region of the spectrum and different emission spectra in the visible region of the spectrum, and the use of such articles as identification documents. US-A-4 897 300 describes a security paper having a security thread embedded therein, running from edge to edge, that is printed with luminescent colors in such a way that they are invisible in normal lighting. The luminescent colors are provided along the security thread in successive overlapping portions which, when the colors are excited, have a length recognizable to the naked eye, and show characteristic mixed fluorescences in the overlapping areas. Finally, US-A-4 500 116 describes an identification document, such as a passport or identification card, provided with a phosphorescent composition which includes at least two phosphorescent activators which exhibit different emission characteristics both with respect to wavelength and lifetime so that, when the composition is irradiated, the initial afterglow changes color, for example from green to blue.

Although fluorescent and phosphorescent materials have been used extensively in commercial identification documents, until now little attention appears to have been paid to the type of image which will appear when the fluorescent or phosphorescent material is excited. So far as the present inventors are aware, all commercial identification documents using fluorescent or phosphorescent materials display only a simple monochrome image or pattern upon excitation; this is true even of the identification document disclosed in the aforementioned US-A-4 500 116, in which a constant mixture of two or more phosphorescent materials is applied to various areas of a substrate so that the phosphorescent image as seen at any given moment is monochromatic, although its color changes with time. With the ever-increasing sophistication of counterfeiters, and the ready commercial availability of fluorescent and phosphorescent materials, it is highly desirable to introduce additional security to non-visible verification features using fluorescent and phosphorescent materials.

It has now been found that the security provided by such non-visible verification features can be enhanced by using multiple fluorescent and/or phosphorescent materials so that upon excitation a full color, and preferably continuous tone, image is displayed. The same type of non-visible indicia may also be used as authentication features (for example, to prove that a particular document emanates from an authorized source) or for esthetic reasons.

Accordingly, this invention provides a substrate having printed thereon an essentially non-visible image, this the non-visible image being formed from at least two fluorescent and/or phosphorescent inks, both or all of which are capable of being excited by a single band of non-visible radiation, the at least two fluorescent and/or phosphorescent inks upon excitation by radiation of the single band producing visible radiation of two different colors, with differing areas of the non-visible image displaying differing colors.

This invention also provides a process for the manufacture of an identifiable substrate; this process comprises printing upon the substrate with a

fluorescent and/or phosphorescent ink, thereby producing upon the substrate an essentially non-visible image, the printing being effected with at least two fluorescent and/or phosphorescent inks, both or all of which are capable of being excited by a single band of non-visible radiation, the at least two fluorescent and/or phosphorescent inks upon excitation by radiation of the single band producing visible radiation of two different colors, with differing areas of the non-visible image displaying differing colors upon excitation by the radiation.

Finally, this invention provides a process for testing the authenticity of a substrate; this process comprising providing upon at least one authentic substrate an essentially non-visible image capable of being excited by a single band of non-visible radiation; and exposing a substrate to be tested to non-visible radiation within the band, and determining whether the exposed substrate displays the non-visible image. The process of the present invention is characterized in that the non-visible image is formed from at least two fluorescent and/or phosphorescent inks, the at least two fluorescent and/or phosphorescent inks upon excitation by radiation of the single band producing visible radiation of two different colors, with differing areas of the non-visible image displaying differing colors.

The term "band of non-visible radiation" is used herein with its conventional meaning of a range of wavelengths not exceeding about 60 nm. Typically, the band used with the present identification document will be the long ultra-violet band (350-400 nm) since ultra-violet sources emitting in this band are inexpensive and readily available. The short ultra-violet (300-350 nm) or other bands may also be used if desired.

The term "substrate" as used herein is to be construed broadly. Thus, for example, the substrate may be an article, such as an identification document, having at least one indicium intended to convey information, or, as will be explained in more detail below, may be a laminate or similar component intended for use in such an identification document. However, the substrate need not be a document in the strict sense of sheets of paper and similar laminar materials bearing printing,

writing or other engraving, but may also be, for example, a container (such as a retail package) or an article, for example a sneaker or a pair of jeans, which may or may not bear a trade or other mark indicating the source of the article.

Figure 1 of the accompanying drawings shows a preferred document incorporating a substrate of the present invention in normal room lighting;

Figure 2 shows the same document as in Figure 1 but seen under ultraviolet light; and

Figure 3 is a schematic cross-section through the preferred document of the present invention.

As already mentioned, the present invention provides a substrate having an essentially non-visible image, this non-visible image being formed from at least two, and preferably at least three fluorescent and/or phosphorescent inks, both or all of which are capable of being excited by a single band of non-visible radiation. Upon excitation by radiation of this single band, the plurality of fluorescent and/or phosphorescent inks produce visible radiation of different colors, with differing areas of the non-visible image displaying differing colors. Thus, upon excitation, the essentially non-visible image on the substrate of the present invention displays as a colored, preferably full-colored, image, which can serve to prove the authenticity of the substrate. Such a full-color image is much more difficult to duplicate than the monochrome fluorescent and phosphorescent images which have hitherto been used in similar substrates, because changes in the colors of such an image are readily detectable, especially if the full-color image is a reproduction of one with which the person checking the substrate is already familiar, for example a heraldic achievement or a corporate or institutional logo. Thus, the presence of the full-color fluorescent or phosphorescent image can provide additional assurance of the authenticity of the substrate, as compared with substrates which display only monochromatic fluorescent and phosphorescent images.

The term "printed" is used herein in the general sense to denote the result of any process in which a marking material is applied to a substrate to generate

a permanent mark. Thus, this term covers not only classic printing techniques such as photogravure, flexographic and lithographic printing, but also printing by means of ink jet printers (using solid or liquid inks), laser printing and electrophotographic printing. Persons skilled in the printing art will appreciate that with some of these printing techniques, the "inks" used will not be conventional liquid inks but solid phase change inks or solid toners.

The term "non-visible image" as used herein does not imply that the image is completely undetectable in visible light. In practice, it is difficult to produce fluorescent and/or phosphorescent images which are completely invisible under normal room lighting, since the inks used to form the non-visible image will usually scatter visible light to some extent, resulting in a ghostly white image being visible where the non-visible image is printed. However, the full-color image is of course seen only when the non-visible image is exposed to the radiation needed to excite the inks. For maximum security, it may be desirable to hide the presence of the non-visible image by overlaying or underlaying a visible image (or, for example, a blank colored area) on the same area of the substrate, provided of course that the visible image or colored area do not excessively obscure the non-visible image when this image is excited. Alternatively, the non-visible image may be "hidden" by being lightly overprinted with the same image in visible colors, which are different from those displayed upon excitation of the non-visible image, so that upon exposure to the exciting radiation, the image appears to change color.

Indeed, in one preferred form of the invention, the same indicium is printed in the same or similar colors in both the visible and non-visible images. For example, a portrait of a bearer of a document (or, for example, a colored logo) could be printed on a specific area in both visible and fluorescent inks. This renders it almost impossible to detect the presence of the fluorescent image, while producing a very distinctive effect when the images are illuminated with ultra-violet radiation. Such a double image may be created in a single step. For example, ink jet printers are known which have the capacity to handle eight different inks, such printers

normally being used in a CCMMYYKK process which uses high and low density of each of the cyan, magenta, yellow and black inks to produce colored images with improved gray scale. Such a printer could readily be modified to use (for example) four visible inks and four fluorescent inks, so that it could print, in a single pass, visible and non-visible versions of the same colored image on the same part of the document.

In general, the use of fluorescent inks is preferred in the present substrate, since proper viewing of images formed with phosphorescent inks usually requires that the substrate be placed in the dark, and placing substrates in a dark location poses obvious problems, especially in situations (such as a passport control booth, a security desk or a retail store) where a single person is required to verify the authenticity of a stream of substrates within a limited time. In such situations, fluorescent images, which can be viewed in normal room lighting, are more convenient to use. Accordingly, the invention will be described below mainly with reference to the use of fluorescent inks, it being understood that any reference to a fluorescent ink may be replaced by reference to a phosphorescent one.

Although the invention is not limited to any particular set of ink colors, in practice the choice of ink colors is normally constrained by the need to be able to produce images having a large color gamut, since for reasons already discussed many potential users will wish to have the fluorescent image reproduce an existing image. Since the fluorescent image is produced by emission of radiation from the fluorescent inks, the colors of the inks used act as *additive* primaries in the same way as the phosphor colors on a cathode ray tube, and to allow a wide color gamut in the image, it is generally preferred that the fluorescent inks upon excitation product at least red, green and blue colors. If it is desired to increase color fidelity in the same way as by moving from a CMY to a CMYK process in a printed visible image, a *white* fluorescent ink may be added as a fourth color.

It has been found that the manner in which the fluorescent inks are applied to the substrate in the present document and process is important in

producing an accurate, high quality, full-color fluorescent image. The two or more (desirably three or more) fluorescent inks should very desirably be present on the substrate in the form of discrete dots, so that the dots of the various colors do not overlap. Preferred printing techniques for securing such non-overlapping dots include gravure and flexographic printing, and ink jet printing.

Also, for obvious reasons, with liquid inks the physical properties of the ink, such as its viscosity, surface tension, pigment loading and size of pigment particles (when the ink contains a pigment, rather than a dye) all affect the quality of the fluorescent image produced. Although no strict numerical limits can be set for such parameters, those skilled in the printing art are familiar with the effects of such parameters on the quality of conventional images produced from inks, and accordingly the formulation of inks suitable for use in the present substrate and process is within the level of skill in the art. It has been found good fluorescent images can be produced with pigment-containing inks having an average particle size not greater than about 3 μm. Moreover, good results have been achieved with water-based inks which contain, in addition to a fluorescent material, a polyacrylate or polyester binder; such inks advantageously also contain a surface active agent to promote a stable dispersion of the pigment within the ink. Dye-based and solvent-based inks may also be used.

The non-visible image on the substrates of the present invention may or may not be accompanied by one or more visible indicia or images. In most cases, the final documents or goods incorporating the substrate needs at least visible indicium or image. For example, if the substrate is to be used in an identification document, the identification document will normally need to include at least one visible indicium, if only to reassure the bearer that he or she is in possession of the correct identification document. It should be noted, however, that in some cases, it may be convenient to prepare a substrate bearing only non-visible images and combine this with another substrate bearing visible images to form a final document. For example, the preferred identification document described below with reference

to Figures 1 and 2 comprises a pouch carrying non-visible images and a laminar member which is enclosed within the pouch and carries visible images. The pouch is conveniently produced from a web of material which carries only non-visible images. Also, there are certain applications of the present invention, for example coupons or similar documents used in promotional schemes, which may carry only non-visible images. Similarly, if the present invention is used to authenticate goods, it may be convenient to provide a non-visible image on parts of the goods (for example, the outside surface of a sneaker or the inside of a pants pocket) where no visible images are normally provided, and in such cases it will normally be desirable not to accompany the non-visible image with any visible image, in order to hide the fact that any authenticating image is present.

The non-visible images in the substrates of the present invention may serve a variety of purposes in validating, identifying or authenticating the substrate or its bearer. For example, as discussed in more detail below with reference to Figures 1 and 2 of the accompanying drawings, the non-visible image may be an image completely unrelated to the visible indicia on a document incorporating the substrate, and may have the form of a logo or similar device associated with a specific organization or company issuing the document, thus proving that the document emanates from an authorized source. Similarly, the present invention may be used to distinguish real from counterfeit goods. It is common practice for producers of goods which can readily be counterfeited (for example, computer software) to mark the packages in which the goods are sold with some security device so that retailers and customers can distinguish authentic goods from counterfeits; holograms are often used for this purpose. The non-visible images provided by the present invention are well adapted for use as this type of security device, since they can be hidden among the normal printing on the package (for example, one could overprint small images in fluorescent inks on the black areas provided by large font black type) so that their presence is not obvious until the authenticity of the package is checked.

The non-visible images might also be placed on goods themselves, rather than on their containers. Counterfeiters of certain goods, for example sneakers, are notorious for copying not only the appearance of well known brands of the goods, but also the trademarks appearing on these goods. Overprinting or otherwise associating the trademark with a non-visible image in accordance with the present invention can assist manufacturers, retailers and consumers in distinguishing authentic goods from counterfeits. If the trademark is in color, the non-visible image could be a reproduction of the color trademark, but the present invention may also be used with monochromatic trademarks; for example, overlaying a monochromatic trademark with a series of stripes in varying colors makes the trademark much more difficult to reproduce.

The present invention may also be of use in promotional schemes. For example, in one common type of such scheme, there are delivered to potential customers coupons having a "scratch off" area in which information is hidden behind a frangible layer, which is readily removed by scratching. The customers are required to visit an establishment of the retailer or other promoter of the scheme, where a staff member removes the frangible layer, thus revealing whether the customer carrying the specific card is entitled to a discount on purchases or some other premium. The frangible layers are so weak that they occasionally are removed by abrasion during delivery to the customer, who is likely to be annoyed upon receiving an invalid coupon. Also, in cases where substantial premiums are involved (for example where one coupon among many thousands distributed entitles a customer to a valuable grand prize), questions have been raised as to whether the conventional frangible layers are sufficiently proof against counterfeiting. Replacing (or supplementing) the frangible layer and the hidden information with a non-visible image in accordance with the present invention would improve both the abrasion resistance and the security of the coupon.

The non-visible image may also be provided for esthetic (a term which is used herein broadly to include entertainment) purposes. For example,

interesting visual effects can be produced without great expense by overprinting a conventional poster with a non-invisible image and arranging for the poster to be intermittently illuminated with an ultraviolet light. Such posters could usefully be employed outside movie theaters to attract customers. Similar interesting visual effects could be used on T-shirts or other garments (especially in haunted houses) or on decorative stickers.

Except for the presence of the non-visible image, the substrates of the present invention, and documents and other devices into which these substrates are incorporated, may be of conventional construction. Thus, an identification document of the present invention may comprise a laminar member and a pouch surrounding this laminar member, the pouch comprising two leaves disposed on opposed sides of the laminar member and sealed to each other around their peripheries so as to completely enclose the laminar member. As is well-known in the art, in such an identification document, it is advantageous to provide an adhesive on the inner surfaces of the pouch leaves so that, by application of heat and/or pressure, the adhesive will laminate the pouch to the laminar member to form a security seal between the two. In a laminar member/pouch type of identification document, both a visible indicium and a non-visible image may be present on the laminar member, on the pouch or on both. However, for security reasons, it is generally preferred that at least one visible data indicium be printed upon the laminar member and at least one non-visible image be present on the interior surface of one leaf of the pouch facing the laminar member. Such an identification document is conveniently mass-produced by printing a plurality of the non-visible images on one surface of a web of cover sheet material, printing a plurality of visible data indicia upon a plurality of laminar members, and thereafter cutting and shaping the cover sheet material to form a plurality of pouches enclosing the laminar members, each of these pouches having at least one non-visible image present on its inner surface facing the laminar member enclosed within that pouch. Printing of the non-visible images on the web can be effected at a central secure facility, thus avoiding the need

to distribute the fluorescent inks and any necessary special printing apparatus to the stations at which issue of the individual identification documents is effected, so that these stations need only be equipped with the pre-printed web, the apparatus necessary to form the visible indicia and apparatus for laminating the web to the laminar members.

A preferred document and process of the present invention will now be described, though by way of illustration only, with reference to the accompanying drawings.

Figure 1 of the accompanying drawings shows a preferred identification document (generally designated 10) of the present invention as it appears in normal room lighting. This identification document 10 is intended for use as a driver's license and comprises a laminar member or card 12 completely enclosed within a pouch 14 which is laminated to the card 12 so as to form a security seal therewith. The card 12 bears a plurality of visible indicia, namely a portrait 16 of the bearer of the license, a license number 18, the social security number 20 of the bearer, the class 22 of the license, the expiration date 24 of the license and the signature 26 of the bearer. The specific identification document 10 also has a visible data indicium 28 provided on the inner surface of one leaf of the pouch 14, this indicium 28 being a machine-readable version of the license number, which is intended to enable police officers to be able to carry out computer license checks. Application of the indicium 28 to the inner surface of the pouch 14 may be effected by the process described in US-A-5 498°305, owned by the present applicant.

Figure 2 shows the identification document 10 as it appears when illuminated with long ultraviolet (350-400 nm) radiation, which can be provided by a small, readily portable and inexpensive battery-powered ultraviolet lamp. From Figure 2, it will be seen that, under the ultraviolet light, the document 10 displays, in addition to all the aforementioned indicia, an image 30 of the heraldic achievement of the government body issuing the license, this image 30 being repeated at regular intervals. The image 30 appears in full, natural color and is located on the inner

surface of the front leaf of the pouch 14, this inner surface being laminated to the card 12 by an adhesive. If desired, this adhesive may be one which forms a security seal, so that if any attempt is made to tamper with the identification document by separating the pouch 14 from the card 12, the security seal will be ruptured and the image 30 irreparably damaged, so that the tampering will be immediately apparent when the identification document is examined under 365 nm radiation.

Figure 3 shows a schematic cross-sections through a preferred identification document of the invention. (For ease of illustration and comprehension, Figure 3 is not to scale; in particular, the thicknesses of the various layers shown in this Figure are greatly exaggerated as compared with their lateral dimensions, and the size of the individual ink dots is also greatly exaggerated.) The identification document shown in Figure 3 has the same card and pouch construction as that shown in Figures 1 and 2, and has a card 32 made of a polymer-based synthetic paper sold by PPG Industries, Inc. under the Registered Trade Mark "TESLIN". The pouch comprises an amorphous poly(ethylene terephthalate) sheet 34 (sold by Transilwrap under the trade name "TXP" carrying on its inside surfaces (those facing the card 32) a layer 36 of an adhesive; preferred adhesives are KRTY (an ethylene-vinyl acetate adhesive) and Transilwrap FG. A non-visible image 38 is printed on the inside surface of the layer 36 of the front leaf of the pouch (to the top in Figure 3); this non-visible image is formed of discrete drops of ink, applied for example by means of an ink jet printer. The pouch is laminated to the card 32, and the peripheries of the two leaves of the pouch laminated to each other, by heat and pressure in the conventional manner to form a security seal between the pouch and the card. The placement of the non-visible image 38 between the adhesive layer 36 and the card 32 ensures that the non-visible image will be irreparably damaged if any attempt is made to separate the card from the pouch. However, the presence of a security seal is not essential and other anti-tampering devices known in the art may be used if desired

It will be apparent to those skilled in the art that numerous changes and modifications can be made to the specific identification documents and processes described above without departing from the scope of the invention. For example, in some cases it may be advantageous to use more than three fluorescent inks, particularly where it is desired to have the non-visible image reproduce a pre-existing image which contains one or more colors (such as certain purples) which do not reproduce very accurately using the normal red, green and blue colors. In such a case, it may be advantageous to include additional fluorescent inks expressly designed to reproduce the color(s) which would otherwise not be accurately reproduced.

Also, in addition to the non-visible images, the document of the present invention may include any other security features known in the art, such as, for example, the lenticular security feature described in US-A-4°402°150, which causes varying optical effects at varying angles of view.

CLAIMS

1. A substrate having printed thereon an essentially non-visible image, characterized in that the non-visible image is formed from at least two fluorescent and/or phosphorescent inks, both or all of which are capable of being excited by a single band of non-visible radiation, the at least two fluorescent and/or phosphorescent inks upon excitation by radiation of the single band producing visible radiation of two different colors, with differing areas of the non-visible image displaying differing colors.

2. A substrate according to claim 1 characterized in that the non-visible image is formed from at least three fluorescent and/or phosphorescent inks.

3. A substrate according to claim 2 characterized in that the at least three fluorescent and/or phosphorescent inks upon excitation produce at least red, green and blue colors.

4. A substrate any one of the preceding claims characterized in that the at least two fluorescent and/or phosphorescent inks each comprise a fluorescent and/or phosphorescent inorganic pigment having a particle size not greater than about 3 μm.

5. A substrate any one of the preceding claims characterized by bearing at least one visible indicium.

6. A substrate according to claim 5 characterized in that it comprises a laminar member bearing the at least one visible indicium and a pouch surrounding the laminar member, the pouch comprising two leaves disposed on opposed sides of the laminar member and sealed to each other around their peripheries so as to completely enclose the laminar member, and also characterized in that the non-visible image is provided on the interior surface of one leaf of the pouch facing the laminar member.

7. A substrate according to claim 5 or 6 characterized in that it is in the form of a container for goods, the container having walls defining an interior

space within the container and the visible and the visible indicium and non-visible image being present upon the outer surfaces of the container.

8. A process for the manufacture of an identifiable substrate, which process comprises printing upon the substrate with a fluorescent and/or phosphorescent ink, thereby producing upon the substrate an essentially non-visible image, characterized in that the printing is effected with at least two fluorescent and/or phosphorescent inks, both or all of which are capable of being excited by a single band of non-visible radiation, the at least two fluorescent and/or phosphorescent inks upon excitation by radiation of the single band producing visible radiation of two different colors, with differing areas of the non-visible image displaying differing colors upon excitation by the radiation.

9. A process according to claim 8 characterized in that printing of the non-visible image on the substrate is effected using at least three fluorescent and/or phosphorescent inks.

10. A process according to claim 9 characterized in that the at least three fluorescent and/or phosphorescent inks upon excitation produce at least red, green and blue colors.

11. A process according to claim 9 or 10 characterized in that the at least two fluorescent and/or phosphorescent inks each comprise a fluorescent and/or phosphorescent inorganic pigment having a particle size not greater than about 3 μm.

12. A process according to any one of claims 9 to 11 characterized in that at least one visible indicium is also printed on the substrate.

13. A process according to claim 12 characterized in that the substrate comprises a laminar member and a cover sheet, the at least one visible data indicium being printed upon the laminar member and the non-visible image being printed upon the cover sheet, and also characterized in that the cover sheet bearing the non-visible image is formed into a pouch surrounding the laminar member, the pouch comprising two leaves disposed on opposed sides of the laminar member and

sealed to each other around their peripheries so as to completely enclose the laminar member, with the non-visible image present on the interior surface of one leaf of the pouch facing the laminar member.

14. A process for testing the authenticity of a substrate, which process comprises:

providing upon at least one authentic substrate an essentially non-visible image capable of being excited by a single band of non-visible radiation;

exposing a substrate to be tested to non-visible radiation within the band, and determining whether the exposed substrate displays the non-visible image,

characterized in that the non-visible image is formed from at least two fluorescent and/or phosphorescent inks, the at least two fluorescent and/or phosphorescent inks upon excitation by radiation of the single band producing visible radiation of two different colors, with differing areas of the non-visible image displaying differing colors.

1/2

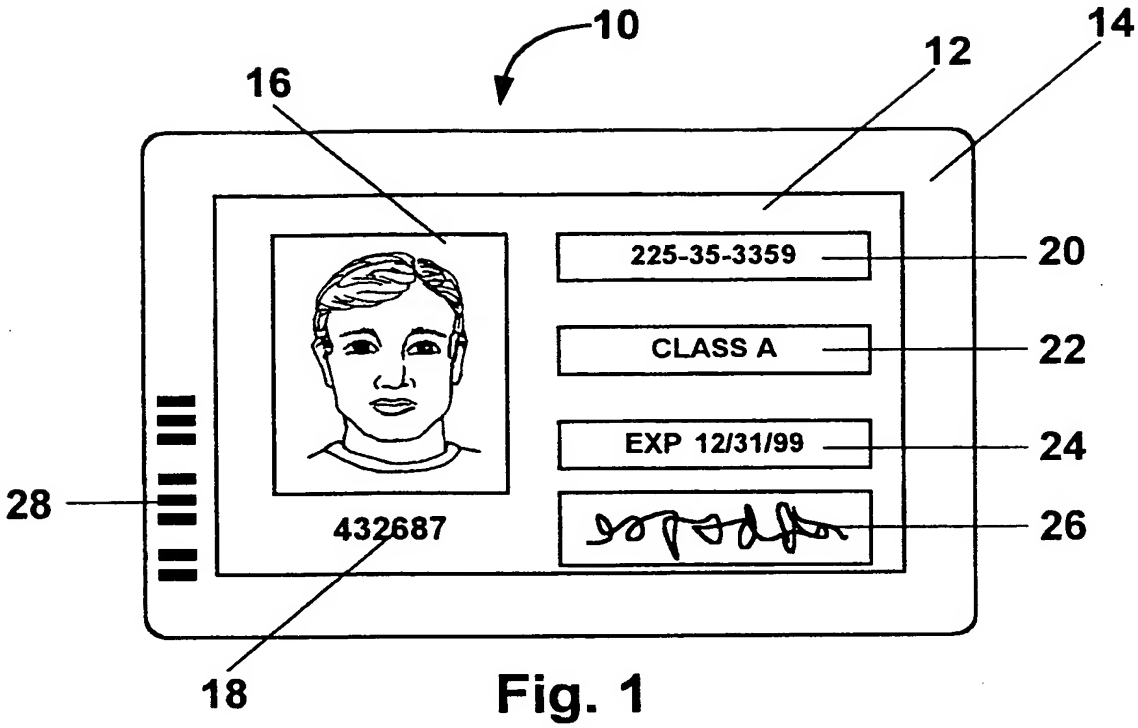

10
12
14
16
225-35-3359
20
CLASS A
22
EXP 12/31/99
24
26
28
432687
18

Fig. 1

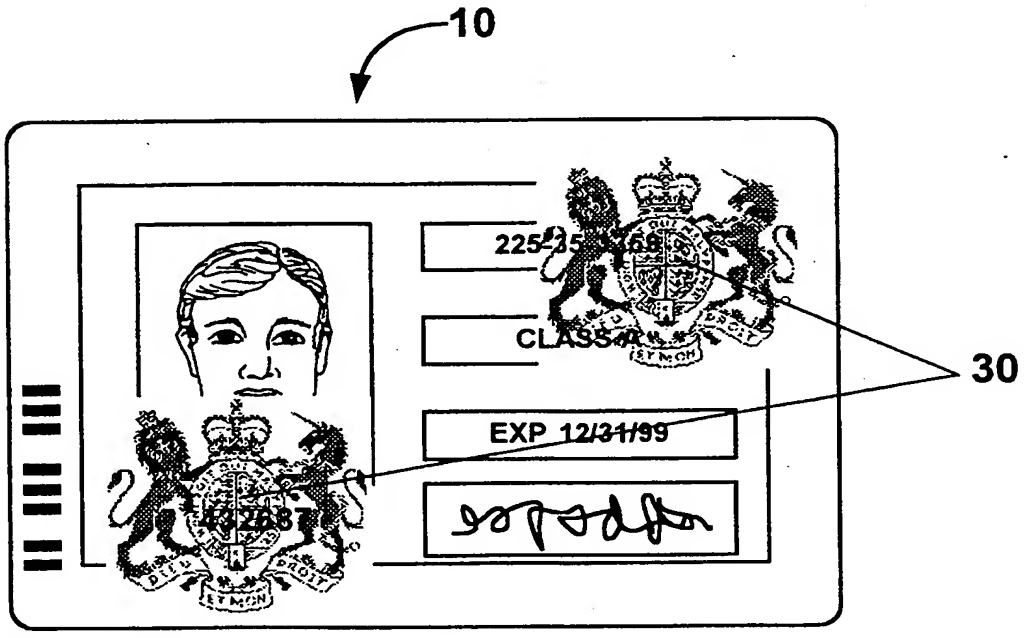

10
CLASS A
EXP 12/31/99
30

Fig. 2

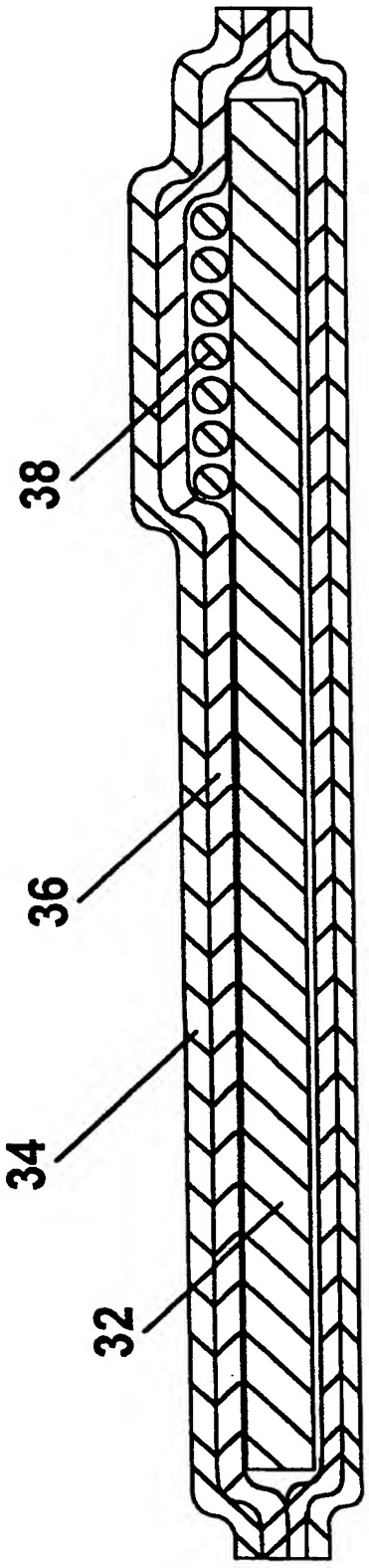


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 98/04672

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B41M 3/14 // B42D 15/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B41M, B42D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
D,X	US 4500116 A (B.M. FERRO ET AL), 19 February 1985 (19.02.85), column 3, line 19 - line 32; column 3, line 42 - line 62; column 4, line 3 - line 62, column 5, line 6-16, figures 1,2	1-3,5-10,12, 13
D,Y	column 4, line 3 - line 62	4,11,14
	--	
Y	US 5695218 A (D. NICOSIA), 9 December 1997 (09.12.97), column 4, line 13 - line 22	4,11
	--	
Y	US 3048697 A (W.J. CAVANAUGH ET AL), 7 August 1962 (07.08.62), column 2, line 69 - line 72; column 3, line 1 - line 9	14
A	the whole document	1-13
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 June 1998	08. 07. 1998
Name and mailing address of the ISA: European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+ 31-70) 340-3016	Authorized officer: Christer Bäcknert

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 98/04672

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	WO 9710958 A1 (THOMAS DE LA RUE LIMITED), 27 March 1997 (27.03.97), the whole document	1-14
	--	
E	WO 9724278 A1 (TETRA LAVAL HOLDING & FINANCE S.A.), 10 July 1997 (10.07.97), page 5, line 11 - line 29; page 6; page 7, page 8, line 1 - line 12	7
	--	
D,A	US 4219599 A (E.M. IDELSON ET AL), 26 August 1980 (26.08.80), column 3, line 1 - line 41, figures	1-14
	--	
D,A	US 4151667 A (E.M. IDELSON ET AL), 1 May 1979 (01.05.79), column 2, line 57 - line 68; column 3, line 1 - line 27, figures	1-14
	--	

INTERNATIONAL SEARCH REPORT

Information on patent family members

29/04/98

International application No.
PCT/US 98/04672

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4500116 A	19/02/85	CA 1108666 A	08/09/81
		EP 0003187 A,B	25/07/79
		GB 2016370 A,B	26/09/79
US 5695218 A	09/12/97	NONE	
US 3048697 A	07/08/62	NONE	
WO 9710958 A1	27/03/97	AU 6995696 A	09/04/97
		GB 9519185 D	00/00/00
WO 9724278 A1	10/07/97	AU 1465697 A	28/07/97
		JP 9188357 A	22/07/97
US 4219599 A	26/08/80	NONE	
US 4151667 A	01/05/79	NONE	

CORRECTED VERSION*

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
B41M 3/14 // B42D 15/10

A1

(11) International Publication Number: WO 98/40223

(43) International Publication Date: 17 September 1998 (17.09.98)

(21) International Application Number: PCT/US98/04672

(22) International Filing Date: 10 March 1998 (10.03.98)

(30) Priority Data:

08/814,966	11 March 1997 (11.03.97)	US
08/963,648	3 November 1997 (03.11.97)	US

(81) Designated States: CA, JP, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

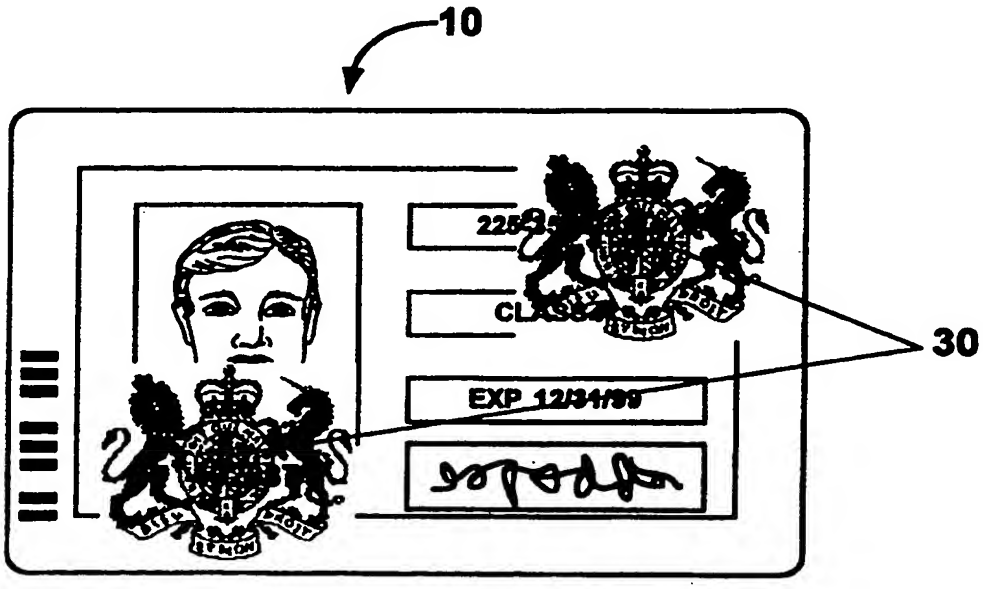
Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(71) Applicant: POLAROID CORPORATION [US/US]; 549 Technology Square, Cambridge, MA 02139–3589 (US).

(72) Inventors: DEMERS, Audrey, G.; 525 Andover Street, Lowell, MA 1852 (US). NESTOR, John, W., Jr.; 11–6 Deer Path, Maynard, MA 01754 (US). RICE, William, C.; 29 Causeway Street, Medway, MA 02053 (US). RICHARDSON, Jack, T.; 29 Robbins Road, Arlington, MA 02174 (US).

(74) Agent: COLE, David, John; Polaroid Corporation, 549 Technology Square, Cambridge, MA 02139–3589 (US).

(54) Title: SUBSTRATE WITH NON–VISIBLE INDICIUM



(57) Abstract

A substrate bears essentially non–visible image formed from at least two fluorescent and/or phosphorescent inks, both or all of which are capable of being excited by a single band of non–visible radiation. The fluorescent and/or phosphorescent inks upon excitation by the appropriate radiation produce visible radiation of two or more different colors, with differing areas of the non–visible image displaying differing colors, so that a full–color image becomes visible. The substrate may also bear visible indicia, and may have the form of, for example, an identification document or a container for goods.

*(Referred to in PCT Gazette No. 12/1999, Section II)

BNSDOCID: <WO_____9840223A1_IA>

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		